

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-256851

(43)Date of publication of application : 11.09.2002

(51)Int.Cl.

F01N 3/08
B01D 53/56
B01D 53/74
B01J 19/08

(21)Application number : 2001-056796 (71)Applicant : DENSO CORP

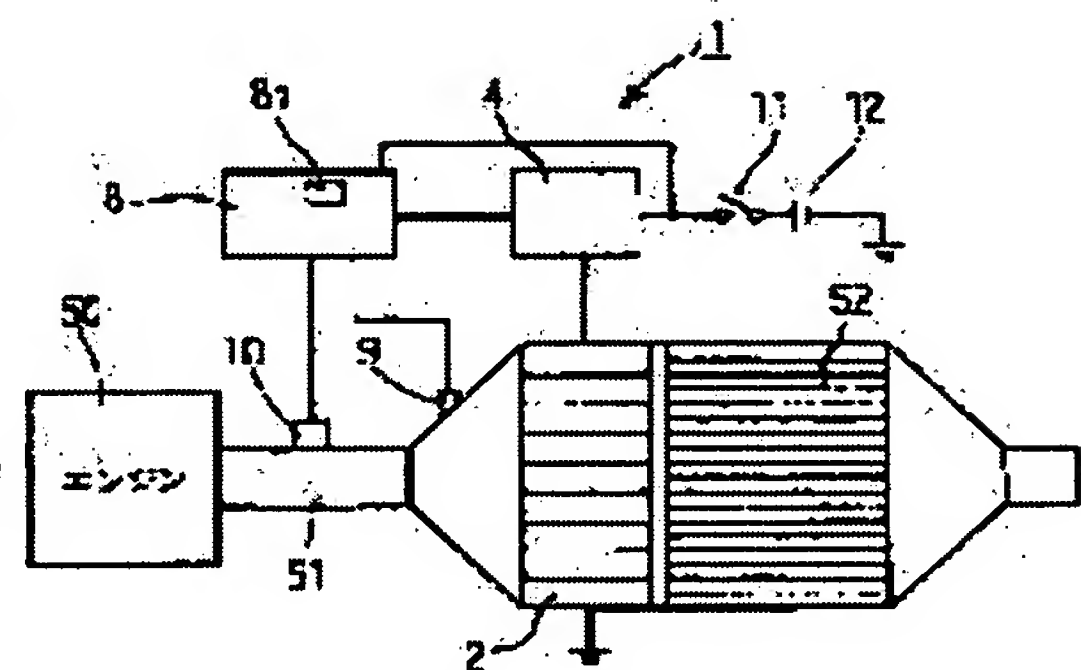
(22)Date of filing : 01.03.2001 (72)Inventor : ARAKAWA MIYAO

(54) EXHAUST GAS PURIFIER OF INTERNAL COMBUSTION ENGINE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an exhaust gas purifier of an internal combustion engine 1 capable of improving the purification efficiency of the exhaust gas by effectively supplying electric power to the electric discharge part.

SOLUTION: In this controller 8, the mean electron energy obtained from each component e (electron quantity) at a discharge field, V (electric voltage value applied between the surface parts of each discharge part opposing with each other), λ (free path of electron) and Gap (distance between the surface parts of each discharge part opposing with each other) is taken into consideration and the mean electron energy at 6 eV as the reaction energy enough to generate a plurality of kind of radicals including O radical requiring the purification of the exhaust gas is provided. V is determined to be the mean electron energy 6 eV from a map data of the temperature, the pressure and V at the discharge field 7 satisfying the mean electron energy 6 eV previously stored in a first memory part 8a and each signal from a temperature sensing part 9 and a pressure sensing part 10, and this V is applied to a plasma generator 2.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

Copyright (C); 1998,2003 Japan Patent Office

* NOTICES *

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] The exhaust emission control device of the internal combustion engine which make do opposite arrangement of two or more discharge sections across the passage where an internal combustion engine's exhaust gas flows, and is characterized by to set the average electronic energy of an acceleration electron which makes it generate in said discharge section as a predetermined value corresponding to the energy value of the acceleration electron made to generate a chemical reaction required for purification of exhaust gas in the exhaust emission control device of the internal combustion engine which purifies exhaust gas by generating discharge in said passage.

[Claim 2] The exhaust emission control device of the internal combustion engine according to claim 1 characterized by setting up the reaction energy which is sufficient for generation of two or more sorts of radicals containing O radical as a chemical reaction required for purification of exhaust gas so that it may become the average electronic energy of said predetermined value.

[Claim 3] The exhaust emission control device of an internal combustion engine given in any 1 term of claim 1 by which it is setting [as said predetermined value]-by electrical-potential-difference value applied between clearance dimension [between said discharge sections] and said discharge section being set up-average electronic energy characterized thru/or claim 2.

[Claim 4] A detection means to detect at least one environmental information which shows the discharge environment condition of said discharge section, A storage means to memorize beforehand the relational data of said environmental information of said discharge section used as the average electronic energy of said predetermined value, and the electrical-potential-difference value applied between said discharge sections, It has the control means which controls the electrical-potential-difference value applied between said discharge sections. Said control means The exhaust emission control device of an internal combustion engine given in any 1 term of claim 1 characterized by carrying out adjustable [of the electrical-potential-difference value applied between said discharge sections based on the signal from said detection means], and doubling with the average electronic energy of said predetermined value thru/or claim 3.

[Claim 5] A temperature detection means to detect the temperature of said discharge section which is said a part of detection means, A 1st storage means to memorize beforehand the relational data of the temperature of said discharge section used as the average electronic energy of said predetermined value, and the electrical-potential-difference value applied between said discharge sections, It is the exhaust emission control device of the internal combustion engine according to claim 4 characterized by having the control means which controls the electrical-potential-difference value applied between said discharge sections, and for said control means carrying out adjustable [of the electrical-potential-difference value applied between said discharge sections based on the signal from said temperature detection means], and doubling with the average electronic energy of said predetermined value.

[Claim 6] A pressure detection means to detect the pressure of said discharge section which is said a part of detection means, A 2nd storage means to memorize beforehand the relational data of the pressure of said discharge section used as the average electronic energy of said predetermined value, and the electrical-potential-difference value applied between said discharge sections, It has the control means which controls the electrical-potential-difference value applied between said discharge sections. Said control means The exhaust emission control device of the internal combustion engine

according to claim 4 or 5 characterized by carrying out adjustable [of the electrical-potential-difference value applied between said discharge sections based on the signal from said pressure detection means], and doubling with the average electronic energy of said predetermined value.

[Claim 7] The average electronic energy of said predetermined value is an exhaust emission control device given in any 1 term of claim 1 characterized by being set up between 5eV and 7eV thru/or claim 6.

[Claim 8] The average electronic energy of said predetermined value is an exhaust emission control device given in any 1 term of claim 1 characterized by being set as 6eV thru/or claim 6.

[Translation done.]

* NOTICES *

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.**** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the exhaust emission control device of the internal combustion engine using especially a plasma generator about the exhaust emission control device of the internal combustion engine which purifies the injurious ingredient in the exhaust gas discharged by the internal combustion engine.

[0002]

[Description of the Prior Art] In recent years, the new emission-gas-purification technique which purifies exhaust gas using spark discharge energy is studied. This technique forms the plasma generator which carried out opposite arrangement of two or more discharge sections across the passage where an internal combustion engine's exhaust gas flows, and purifies exhaust gas by generating discharge in passage as indicated by JP,5-59934,A. And having had the control means which controls the electric energy to a plasma generator to optimize the purification engine performance of the exhaust gas by discharge corresponding to an internal combustion engine's load effect is indicated.

[0003]

[Problem(s) to be Solved by the Invention] However, in JP,5-59934,A, although there is a publication that it has the control means controlled to optimize electric energy, the concrete technique of this control means is not indicated. Moreover, since the situation that electronic energy serves as a situation which runs short of the energy of the electron which is needed for purifying exhaust gas depending on the control means of the electric energy to a plasma generator, or a situation which becomes superfluous conversely, and an increment or emission-gas-purification engine performance of power consumption are not demonstrated arises, it is a problem.

[0004] The purpose of this invention is to offer the exhaust emission control device of the internal combustion engine which becomes possible [supplying power to the discharge section efficiently and raising the purification effectiveness of exhaust gas in view of the above-mentioned point,].

[0005]

[Means for Solving the Problem] In order to solve the technical problem mentioned above, according to the exhaust emission control device of the internal combustion engine of this invention according to claim 1, it is characterized by setting the average electronic energy of an acceleration electron which makes it generate as a predetermined value corresponding to the energy value of the acceleration electron made to generate a chemical reaction required for purification of exhaust gas.

[0006] That is, the artificer noted setting the average electronic energy of an acceleration electron which makes it generate in the discharge section as a predetermined value so that it might correspond to the energy value of the acceleration electron made to generate a chemical reaction required for purification of exhaust gas. It is expressed as average electronic energy $= e \times V \times (\lambda / \text{Gap})$ mentioned above here, and is well-known. In addition, the amount [in / in e / discharging space (space between the discharge sections which carried out opposite arrangement)] of electrons, the electrical-potential-difference value between the discharge sections which V made carry out opposite arrangement (between the surface sections of each discharge section which counters), and λ show an electronic (e) mean free path and the distance between the discharge section surface sections in which Gap carried out opposite arrangement.

[0007] Thus, if the average electronic energy of a parenthesis is set as a predetermined value in consideration of the average electronic energy which can be found from each components e , V , λ , and Gap in discharging space, the exhaust emission control device of the internal combustion engine which becomes possible [supplying power to the discharge section efficiently and raising the purification effectiveness of exhaust gas] can be offered.

[0008] According to the claim 2 publication of this invention, it is characterized by setting up the reaction energy which is sufficient for generation of two or more sorts of radicals containing O radical as a chemical reaction required for purification of exhaust gas so that it may become the average electronic energy of a predetermined value.

[0009] Purification of exhaust gas is purified by harmless gas constituents by working so that two or more sorts of radicals containing O radical generated by applying power to the discharge section may promote oxidation reaction of the injurious ingredient in exhaust gas. That is, it is lost that the situation which runs short of the energy of the electron which makes two or more sorts of radicals containing O radical which is needed for purifying exhaust gas if the reaction energy which is sufficient for generation of two or more sorts of radicals containing O radical which is needed for purification of exhaust gas is set up so that it may become the average electronic energy of a predetermined value generate, or the situation where of the energy of the electron which makes two or more sorts of radicals which contain O radical conversely generate becomes superfluous occur. Therefore, the exhaust emission control device of the internal combustion engine which becomes possible [supplying power efficiently and raising the purification effectiveness of exhaust gas] can be offered.

[0010] According to the claim 3 publication of this invention, it considers as the setting [as the predetermined value]-by electrical-potential-difference value applied between clearance dimension [between the discharge sections] and the discharge section being set up-average electronic energy description.

[0011] Since it is expressed as average electronic-energy $=exVx (\lambda/\text{Gap})$, if the clearance dimension between the discharge sections (distance between the discharge section surface sections which carried out Gap :opposite arrangement), and the electrical-potential-difference value (V) applied between the discharge sections are adjusted, a setup of average electronic energy used as the energy of the electron which makes two or more sorts of radicals containing O radical which is needed for purifying exhaust gas generate will be easily made to a predetermined value.

[0012] A detection means to detect at least one environmental information which shows the discharge environment condition of the discharge section according to the claim 4 publication of this invention, A storage means to memorize beforehand the relational data of the environmental information of the discharge section used as the average electronic energy of a predetermined value, and the electrical-potential-difference value applied between the discharge sections, It is characterized by having the control means which controls the electrical-potential-difference value applied between the discharge sections, and for a control means carrying out adjustable [of the electrical-potential-difference value applied between the discharge sections based on the signal from a detection means], and doubling with the average electronic energy of a predetermined value.

[0013] Thus, if adjustable [of the electrical-potential-difference value applied between the discharge sections based on the signal from a detection means to detect at least one environmental information which shows the discharge environment condition of the discharge section] is carried out and it doubles with the average electronic energy of a predetermined value, average electronic energy can be doubled with a predetermined value corresponding to the discharge environment condition of the discharge section.

[0014] A temperature detection means to detect the temperature of the discharge section which is a part of detection means according to the claim 5 publication of this invention, A 1st storage means to memorize beforehand the relational data of the temperature of the discharge section used as the average electronic energy of a predetermined value, and the electrical-potential-difference value applied between the discharge sections, It is characterized by having the control means which controls the electrical-potential-difference value applied between the discharge sections, and for a control means carrying out adjustable [of the electrical-potential-difference value applied between the discharge sections based on the signal from a temperature detection means], and doubling with

the average electronic energy of a predetermined value.

[0015] Here, the electronic (e) mean free path λ changes according to change of the temperature of the discharge section, and it is known that there is a fixed correlation. Then, the relational data of the temperature of the discharge section and the electrical-potential-difference value applied between the discharge sections is beforehand memorized for the 1st storage means, and if it carries out adjustable [of the electrical-potential-difference value applied between the discharge sections based on the signal from a temperature detection means by which a control means detects the temperature of the discharge section], it can double with the average electronic energy of a predetermined value corresponding to change of the temperature of the discharge section.

[0016] A pressure detection means to detect the pressure of the discharge section which is a part of detection means according to the claim 6 publication of this invention, A 2nd storage means to memorize beforehand the relational data of the pressure of the discharge section used as the average electronic energy of a predetermined value, and the electrical-potential-difference value applied between the discharge sections, It is characterized by having the control means which controls the electrical-potential-difference value applied between the discharge sections, and for a control means carrying out adjustable [of the electrical-potential-difference value applied between the discharge sections based on the signal from said pressure detection means], and doubling with the average electronic energy of a predetermined value.

[0017] Here, an electronic (e) mean free path (λ) changes according to change of the pressure of the discharge section, and it is known that there is a fixed correlation. Then, the relational data of the pressure of the discharge section and the electrical-potential-difference value applied between the discharge sections is beforehand memorized for the 2nd storage means, and if it carries out adjustable [of the electrical-potential-difference value applied between the discharge sections based on the signal from a pressure detection means by which a control means detects the pressure of the discharge section], it can double with the average electronic energy of a predetermined value corresponding to change of the pressure of the discharge section.

[0018] According to the claim 7 publication of this invention, average electronic energy of a predetermined value is characterized by being set up between 5eV (5 electron volts) and 7eV (7 electron volts).

[0019] If average electronic energy is set up between 5eV and 7eV as reaction energy which is sufficient for generation of two or more sorts of radicals containing O radical which is needed for purification of exhaust gas, a setup of the power which makes two or more sorts of radicals containing O radical which is needed for purifying exhaust gas the neither more nor less generate will be attained.

[0020] According to the claim 8 publication of this invention, average electronic energy of a predetermined value is characterized by being set as 6eV (6 electron volts).

[0021] If average electronic energy is set as 6eV as reaction energy which is sufficient for generation of two or more sorts of radicals containing O radical which is needed for purification of exhaust gas, a setup of the power which makes two or more sorts of radicals containing O radical which is needed for purifying exhaust gas the neither more nor less generate will be attained.

[0022]

[Embodiment of the Invention] Hereafter, the exhaust emission control device of the internal combustion engine which is 1 operation gestalt of this invention is explained to a detail with reference to a drawing. In addition, the car which carried the diesel power plant as an internal combustion engine's example is equipped with the exhaust emission control device of the internal combustion engine of this invention. And as it corresponds to the energy value of the acceleration electron made to generate a chemical reaction required for purification of exhaust gas, an artificer is setting this average electronic energy as a predetermined value paying attention to setting the average electronic energy of an acceleration electron which makes it generate in the discharge section as a predetermined value, and is the exhaust emission control device of the internal combustion engine which supplies power to the discharge section efficiently and raises the purification effectiveness of exhaust gas.

[0023] First, the configuration of an exhaust emission control device is explained using drawing 6 and drawing 7 . Drawing 6 is the outline block diagram showing the exhaust-emission-control-device

1 whole of 1 operation gestalt of this invention. Drawing 7 is the outline block diagram of the plasma generator shown in drawing 6.

[0024] The plasma generator 2 arranged in the middle of the exhaust pipe 51 of the engine 50 whose exhaust emission control device 1 is an internal combustion engine as shown in drawing 6, The high voltage power supply generating section 4 which impresses the alternating current high voltage of a RF to this plasma generator 2, The pressure detection section 10 which detects the temperature of the discharge section in the plasma generator 2, The temperature detection section 9 which detects the temperature of the discharge section in the plasma generator 2, and the control section 8 which controls the energization to the discharge section based on the signal from the temperature detection section 9 and the pressure detection section 10, It is constituted by the DPF(Diesel Particulate Filter) 52 grade with a catalyst arranged in the exhaust gas downstream location of the plasma generator 2.

[0025] In addition, the above-mentioned temperature detection section 9 and the above-mentioned pressure detection section 10 are a part of detection means to detect the environmental information which shows the discharge environment condition of the discharge section, for example, the pressure and temperature in the discharge section are fixed to a measurable location, without being influenced of the plasma generated when it energizes in the discharge section. And the current supply for operating the high-voltage-power-supply generating section 4 and a control section 8 is a configuration in which current supply is carried out by ON of the key switch (IG switch) 11 of a car from the mounted dc-battery 12. In addition, in the control section 8, it has memory section 8a, and this memory section 8a constitutes claim 4 and the 1st and 2nd storage means according to claim 5. In addition, the detail of memory section 8a is mentioned later.

[0026] Next, the configuration of the plasma generator 2 is explained using drawing 7. In the plasma generator 2, two or more insulating substrates 5 are arranged in parallel at intervals of predetermined, and the flat passage 6 through which exhaust gas passes between each insulating substrate 5 is formed. Each insulating substrate 5 is formed with heat-resistant insulators (for example, ceramics, such as an alumina, glass, etc.). And in each insulating substrate 5, the electrode 3 for discharge formed with the printed conductor or the electric conduction plate, respectively is embedded. Connection terminal area 3a formed in one side of each of this electrode 3 is connected to the high voltage power supply generator 4 which generates the high-pressure alternating voltage of a RF, and another side is connected to the gland (ground potential) side. In addition, 7 shows the space between the discharge sections which carried out opposite arrangement, i.e., the discharging space across which it faces between electrodes 3.

[0027] Thus, each electrode 3 is made to counter across the passage 6 where exhaust gas flows, it arranges, the alternating current high voltage of the RF from the high voltage power supply generating section 4 is impressed to the electrode 3 of these plurality, the plasma is generated, an electrode 3 and an insulating substrate 5 are united, and the discharge section according to claim 1 is constituted. And Gap shown in drawing 7 shows the distance between the discharge section surface sections which carried out opposite arrangement, and shows the distance between the insulating-substrate 5 surface sections with this gestalt.

[0028] Next, the configuration of the control section 8 which controls the energization to the discharge section based on the signal from the temperature detection section 9 and the pressure detection section 10 is explained. In the control section 8, it has 2nd memory section 8b as the 2nd storage means which memorizes beforehand the relational data of the pressure of the discharge section used as 1st memory section 8a as the 1st storage means which memorizes beforehand the relational data of the temperature of the discharge section used as the average electronic energy of a predetermined value, and the electrical-potential-difference value applied between the discharge sections, and the average electronic energy of a predetermined value, and the electrical-potential-difference value applied between the discharge sections.

[0029] And a control section 8 is a configuration which sends a signal to the high voltage power supply generating section 4 so that the electrical-potential-difference value applied between the discharge sections from the data of memorized 1st memory section 8a and 2nd memory section 8b and the signal from the temperature detection section 9 and the pressure detection section 10 may be computed, adjustable [of the electrical-potential-difference value applied between the discharge sections based on this calculation result] may be carried out and it may double with the average

electronic energy of a predetermined value. In addition, about the average electronic energy of the predetermined value mentioned above, it mentions later. Moreover, the electrical-potential-difference value applied between the discharge sections is an electrical-potential-difference value between the insulating-substrate 5 surface sections which show the electrical-potential-difference value between the discharge section surface sections which counter, and counter with this gestalt.

[0030] Drawing 8 is the property Fig. showing an example of the voltage waveform applied to the discharge section in drawing 7, and the electrical potential difference applied between the discharge section surface sections is a single-sided electrical-potential-difference value bordering on the Gnd level in the alternating current impression electrical potential difference bordering on Gnd level.

[0031] Next, an approximate account is carried out about the configuration of DPF52 with a catalyst. DPF52 with a catalyst has a close side house, and this close side house and ***** side house of the dead end, and it is making the septum support a catalyst while enabling passage of exhaust gas by making the septum of both ** into porosity ceramic material. The catalyst supported to a septum is united with an exhaust gas presentation situation. NOx In addition, occlusion, The NOx occlusion catalyst to discharge, the selection reduction catalyst which divides NOx into N2 and O2 by reducibility components in exhaust gas, such as HC, CO, and H2, Which catalyst of the three-way catalyst which carries out purification processing of the three injurious ingredients, HC, CO, and NOx, at coincidence, and the oxidation catalyst which carries out purification processing of the injurious ingredient of HC and CO is chosen, or it is used combining two or more catalysts.

[0032] Next, a view, an approach, etc. of setting the average electronic energy of an acceleration electron which makes it generate in the discharge section as a predetermined value are explained below so that it may correspond to the energy value of the acceleration electron made to generate a chemical reaction required for purification of exhaust gas.

[0033] First, average electronic energy is explained using drawing 1 and drawing 2. Drawing 1 is an explanatory view explaining average electronic energy. Drawing 2 is the explanatory view showing the electronic energy distribution in the discharging space 7. As shown in drawing 1, Gap is set up as a distance between the surface sections of the discharge section (this gestalt each insulating substrate 5) which counters, and the electrical potential difference of the electrical-potential-difference value V is impressed between both the discharge sections. And at this time, two or more e (electron) 20a which can be set at the discharging space 7 across which it faced between both the discharge sections, and 20b have each free paths λ_1 and λ_2 with variation, and collide with gas molecules 21a and 21b.

[0034] The average electronic energy in this discharging space 7 is expressed as $eV \times (\lambda / \text{Gap})$, and is well-known. In addition, the amount [in / in e in a front type / discharging space (space between the discharge sections which carried out opposite arrangement)] of electrons, the electrical-potential-difference value impressed between the discharge sections which V made carry out opposite arrangement (between the surface sections of each discharge section which counters), and λ show an electronic (e) mean free path and the distance between the discharge section surface sections in which Gap carried out opposite arrangement.

[0035] Thus, if the average electronic energy of a parenthesis is set as a predetermined value in consideration of the average electronic energy which can be found from each components e, V, λ , and Gap in the discharging space 7, it will become the exhaust emission control device 1 of the internal combustion engine which becomes possible [supplying power to the discharge section efficiently and raising the purification effectiveness of exhaust gas]. Moreover, a setup of the power which makes two or more sorts of radicals containing O radical which is needed for purifying exhaust gas the neither more nor less by setting up this average electronic energy between 5eV and 7eV generate is attained. Power is most efficiently set up by setting it as 6eV (6 electron volts) which is the mean value of 5 to 7eV mentioned above, and two or more sorts of radicals containing O radical are made to generate with this operation gestalt.

[0036] Moreover, since the electron (e) has each free paths λ_1 and λ_2 with variation, it shows electronic energy distribution as shown in drawing 2. The graph axis of abscissa of drawing 2 is the indexation indicated value of the electronic energy value by the free-path (λ) die-length difference in an electron (e) here, and a graph axis of ordinate is a frequency value which shows free-path die-length distribution of two or more electrons (e) corresponding to an axis of abscissa.

That is, the part of axis-of-abscissa 1A in drawing 2 shows a mean free path (λ), and sets it as 6eV as the electronic energy computed based on this mean free path (λ), i.e., average electronic energy.

[0037] Here, in order to be referred to as 6eV of the predetermined value which mentioned average electronic energy above, as shown in drawing 3, it can set up by the distance (Gap) between the discharge section surface sections, and adaptation with the electrical-potential-difference value (V) impressed between the surface sections of each discharge section which counters. Drawing 3 is the property Fig. showing the relation between Discharge Gap and applied voltage. Characteristic ray (**) in drawing 3 shows the distance (Gap) between the discharge section surface sections which satisfy 6eV as the predetermined temperature in the discharging space 7, and average electronic energy under a flow and pressure requirement, and relation with the electrical-potential-difference value (V) impressed between the surface sections of each discharge section which counters.

[0038] In addition, it is known that an electronic (e) free path (λ) will change with the type of gas in the discharging space 7, temperature, pressures, etc. Then, in order to set average electronic energy to 6eV of a predetermined value, as shown in drawing 4, it can set up by the temperature in the discharging space 7, and adaptation with the electrical-potential-difference value (V) impressed between the surface sections of each discharge section which counters. Drawing 4 is the property Fig. showing the relation of the temperature and applied voltage in the discharging space 7 with which are satisfied of the average electronic energy of a predetermined value. The characteristic ray in drawing 4 (Ha) shows the temperature in the discharging space 7 with which it is satisfied of 6eV as average electronic energy under the distance (Gap) setups between the discharge section surface sections in the discharging space 7, and relation with the electrical-potential-difference value (V) impressed between the surface sections of each discharge section which counters.

[0039] Moreover, as shown in drawing 5, in order to set average electronic energy to 6eV of a predetermined value, it can set up by adaptation with the pressure in the discharging space 7, and the electrical-potential-difference value (V) impressed between the surface sections of each discharge section which counters. Drawing 5 is the property Fig. showing the relation of the pressure and applied voltage in the discharging space with which are satisfied of the average electronic energy of a predetermined value. Characteristic ray (**) in drawing 5 shows the relation between the pressure in the discharging space 7 with which it is satisfied of 6eV as average electronic energy under the temperature setups in the discharging space 7, and the electrical-potential-difference value (V) impressed between the surface sections of each discharge section which counters.

[0040] Relational data of 3 yuan with the temperature in the discharging space 7 with which are satisfied of 6eV of average electronic energy mentioned above, the pressure in the discharging space 7, and the electrical-potential-difference value (V) impressed between the surface sections of each discharge section which counters is beforehand stored in 1st memory section 8a in a control section 8 as map data. And if a signal is respectively outputted to a control section 8 from the temperature detection section 9 and the pressure detection section 10, the electrical-potential-difference value (V) impressed between the surface sections of each discharge section which counters using the 3 yuan map data stored in 1st memory section 8a within a control section 8 will be computed.

[0041] An operation of the exhaust emission control device 1 constituted as mentioned above is explained below. An engine 50 starts, and when the exhaust gas containing injurious ingredients, such as gaseous pollutants, such as NO_x, and particulate matter (PM), is led to the plasma generator 2 through an exhaust pipe 51, according to the command from a control section 8, the high voltage power supply generator 4 impresses the high-pressure alternating voltage of a RF to two or more electrodes 3 which counter across each passage 6.

[0042] The electrical-potential-difference value (V) of the high-pressure alternating voltage of this RF is computed using the 3 yuan map data stored in the control section 8 within the control section 8 at 1st memory section 8a based on the signal outputted respectively from the temperature detection section 9 and the pressure detection section 10. And the high voltage power supply generator 4 is ordered a control section 8 so that it may become the electrical-potential-difference value (V) computed between the surface sections of each discharge section which counters, and the high-pressure alternating voltage of a RF is impressed to an electrode 3.

[0043] When the high-pressure alternating voltage of this RF is impressed to an electrode 3 and

discharge occurs between the discharge sections, the oxygen molecule in exhaust gas and the acceleration electron e by discharge react, and two or more sorts of radicals containing O radical (O^*) are generated. And this O radical (O^*) etc. and the nitrogen monoxide in exhaust gas (NO) join together, and a nitrogen dioxide (NO_2) is generated.

[0044] Here, purification of the particulate matter in the exhaust gas which is an injurious ingredient (PM) is divided roughly into the soot (SOOT) which uses carbon (C) as a principal component, and the non-burned body (S. O.F.) which uses a hydrocarbon (HC) as a principal component. It reacts, as it is indicated in a degree type as this carbon (C) and a hydrocarbon (HC), and the nitrogen dioxide (NO_2) generated by discharge.

[0045] In the case of soot (SOOT), it is set to $C+NO_2 \rightarrow CO_2+NO$, and, in the case of the non-burned body (S. O.F.), reacts like $HC+NO_2 \rightarrow CO_2+H_2O+NO$. In addition, since particulate matter (PM) and the nitrogen dioxide (NO_2) generated by discharge react also under a low-temperature environment, it is effective in a diesel power plant with low exhaust gas temperature. Such a reaction is generated by the septum of DPF32 with a catalyst arranged in the exhaust gas downstream location of the plasma generator 2 and the plasma generator 2.

[0046] Next, the cleaning effect of the nitrogen oxides (NO_x) of the gaseous contaminant which is an injurious ingredient is explained. Nitrogen oxides (NO_x) are conjugated compounds of a nitrogen dioxide (NO_2) and a nitrogen monoxide (NO), oxidize the nitrogen monoxide (NO) in these nitrogen oxides (NO_x), and the nitrogen monoxide (NO) generated in the reaction process of particulate matter (PM) by O radical (O^*) generated by discharge, and make a nitrogen dioxide (NO_2) generate. And a nitrogen dioxide (NO_2) carries out a reduction reaction, as shown in a degree type, serves as harmless gas (CO_2 , N_2) and water, and is discharged. In addition, the hydrocarbon (HC) which is a reducing agent is contained in exhaust gas as a non-burned component. The reduction reaction formula of a nitrogen dioxide (NO_2) is set to $NO_2+HC \rightarrow N_2+CO_2+H_2O$, and is purified by harmless gas.

[0047] Thus, purification of exhaust gas is purified by harmless gas constituents by working so that two or more sorts of radicals containing O radical generated by applying power to the discharge section may promote oxidation reaction of the injurious ingredient in exhaust gas. By that is, the thing to consider as the exhaust emission control device 1 equipped with the control section 8 which sets up the reaction energy which is sufficient for generation of two or more sorts of radicals containing O radical which is needed for purification of exhaust gas so that it may become the average electronic energy of a predetermined value. It is lost that the situation which runs short of the energy of the electron which makes two or more sorts of radicals containing O radical which is needed for purifying exhaust gas generate, or the situation where the energy of the electron which makes two or more sorts of radicals which contain O radical conversely generate becomes superfluous occurs. Therefore, the exhaust emission control device 1 of the internal combustion engine which becomes possible [supplying power efficiently and raising the purification effectiveness of exhaust gas] can be offered.

[0048] Next, the procedure of the energization control to the discharge section which a control section 8 performs is explained based on the flow chart shown in drawing 9. If an engine 50 starts by ON of the key switch (IG switch) 11 of a car in S10 (S expresses a step) first, a control section 8 will receive the signal (temperature data and pressure data) from the temperature detection section 9 and the pressure detection section 10 (S20). Subsequently, in S30, a control section 8 receives a signal respectively from the temperature detection section 9 and the pressure detection section 10, and computes the electrical-potential-difference value (V) impressed between the surface sections of each discharge section which counters 1st memory section 8a in a control section 8 using the 3 yuan map data memorized beforehand. And in S40, the high voltage power supply generator 4 is ordered a control section 8 so that it may become the computed electrical-potential-difference value (V), the high voltage power supply generator 4 impresses the high-pressure alternating voltage of a RF to two or more electrodes 3 which counter across each passage 6, and it carries out end termination of the processing concerned.

[0049] In addition, although this operation gestalt showed the discharge section with which the electrode 3 and the insulating substrate 5 were united, average electronic energy is called for in consideration of the electrical-potential-difference value (V) impressed to the distance (Gap)

between the surface sections of each electrode 3 which counters when the discharge section consists of only electrodes 3.

[Translation done.]

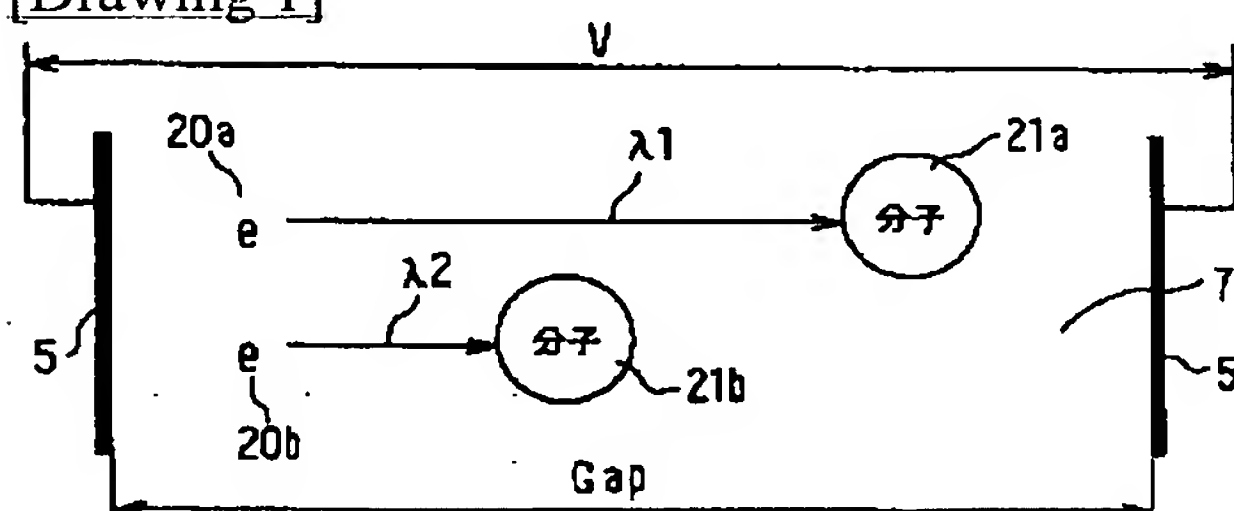
* NOTICES *

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

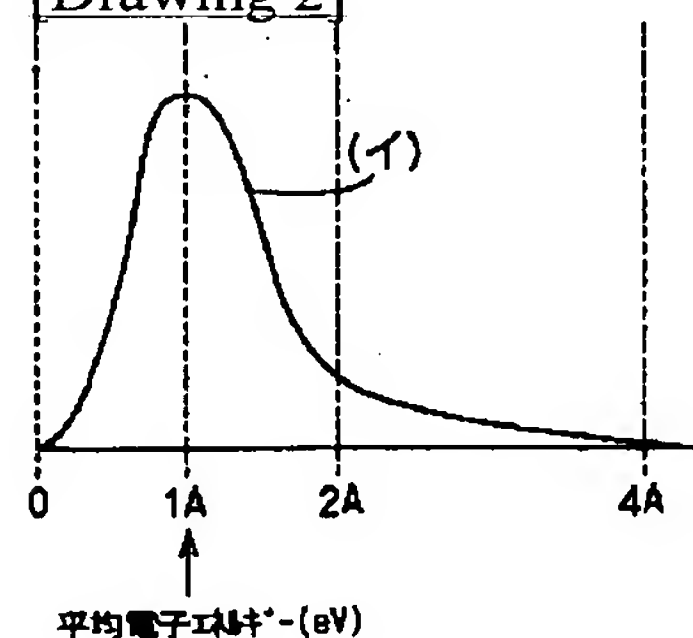
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DRAWINGS

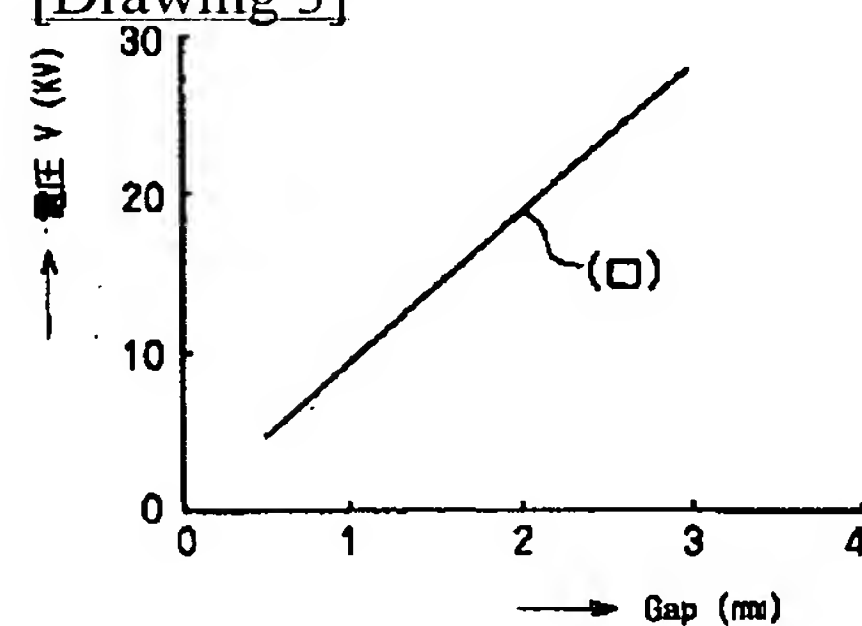
[Drawing 1]



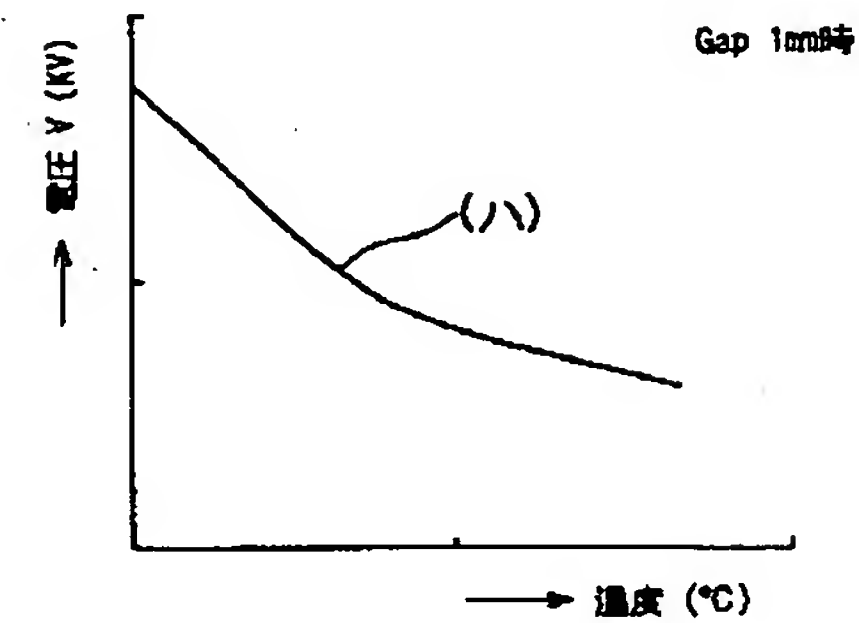
[Drawing 2]



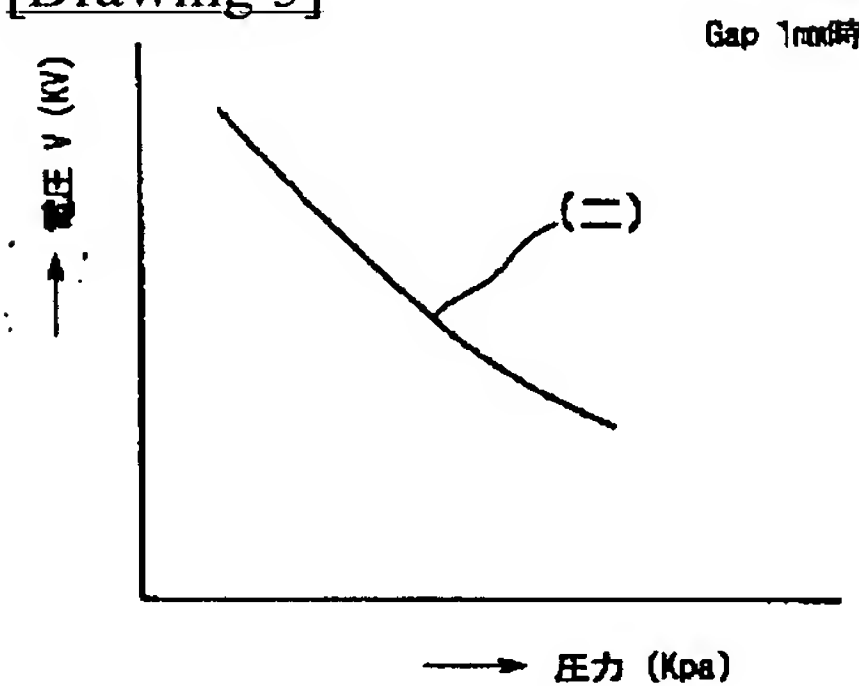
[Drawing 3]



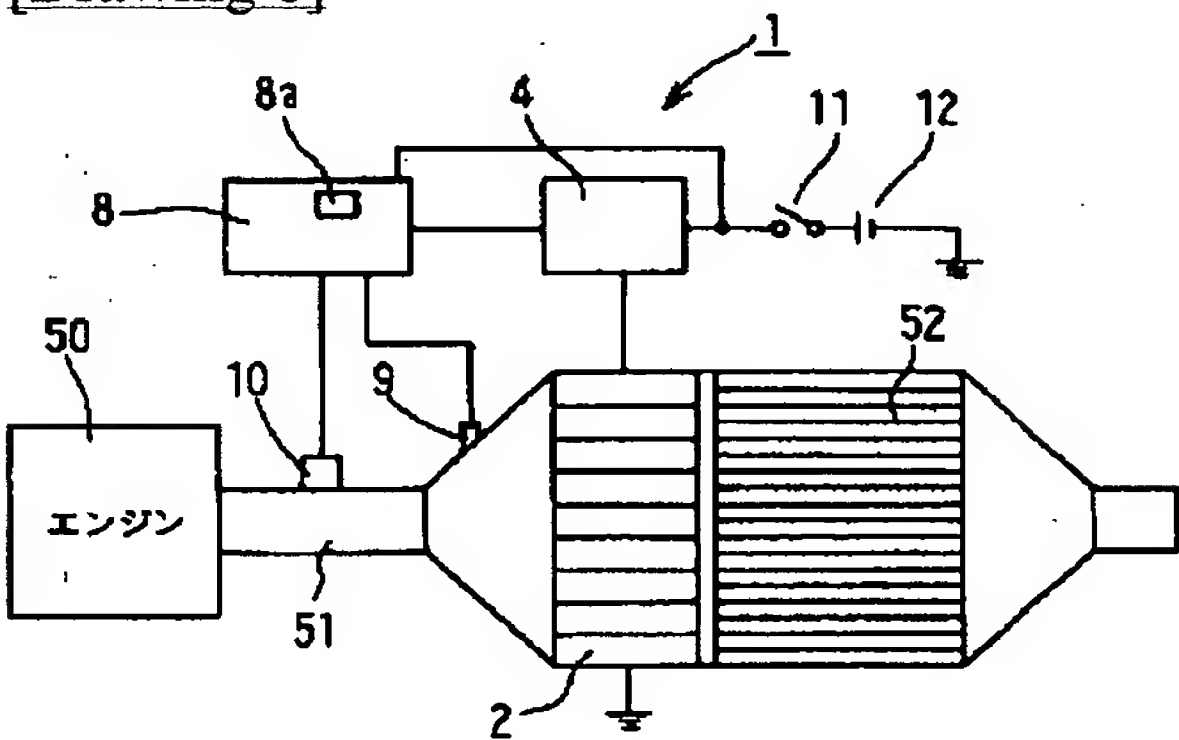
[Drawing 4]



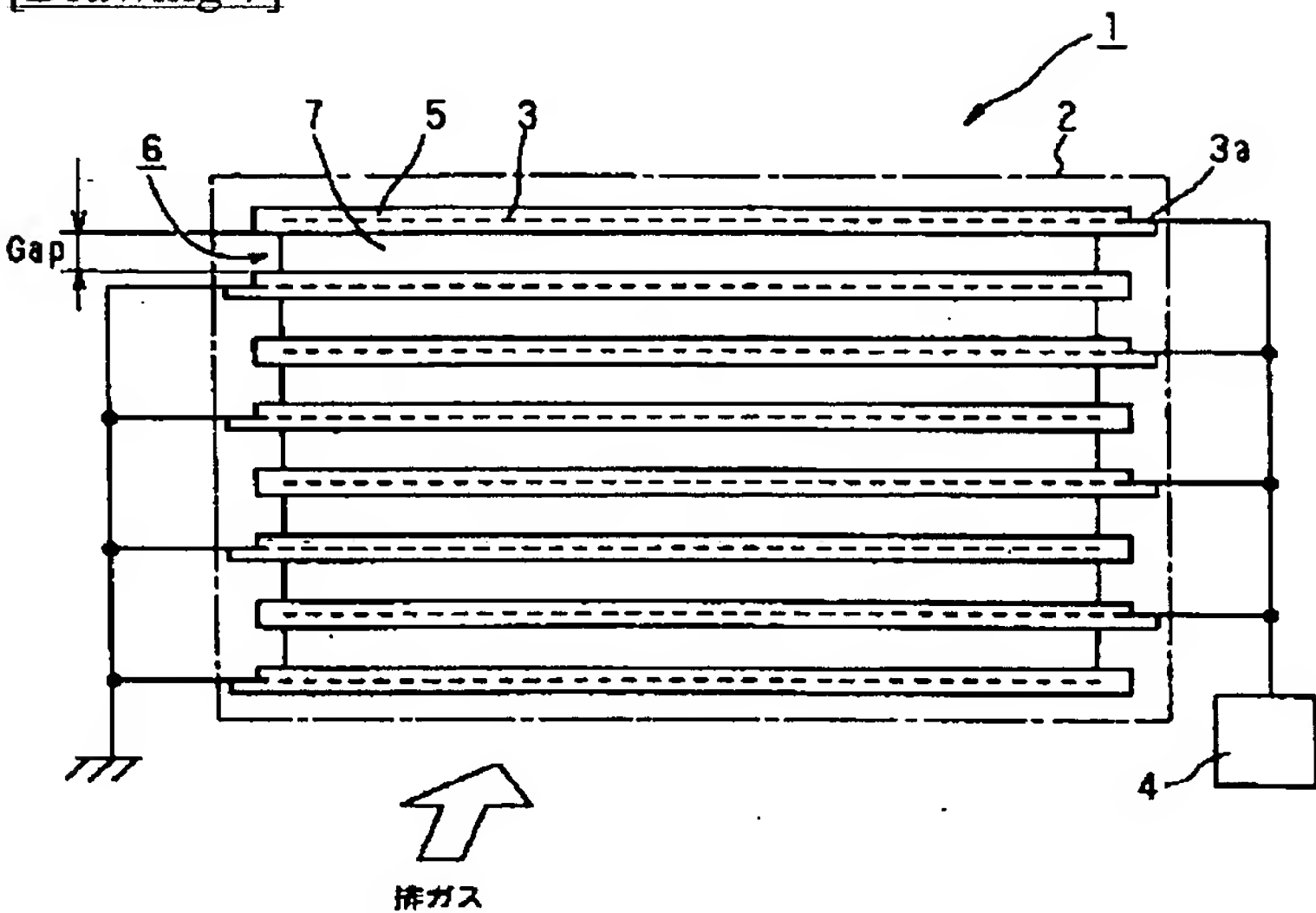
[Drawing 5]



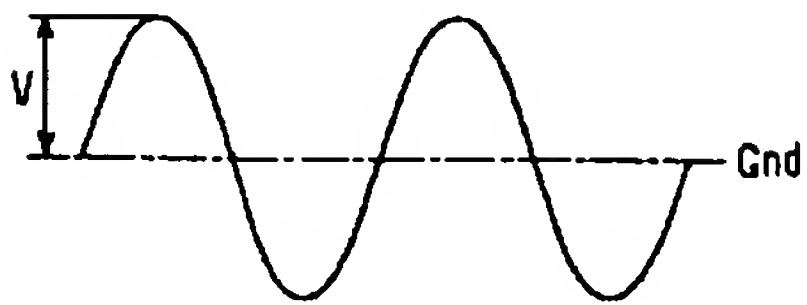
[Drawing 6]



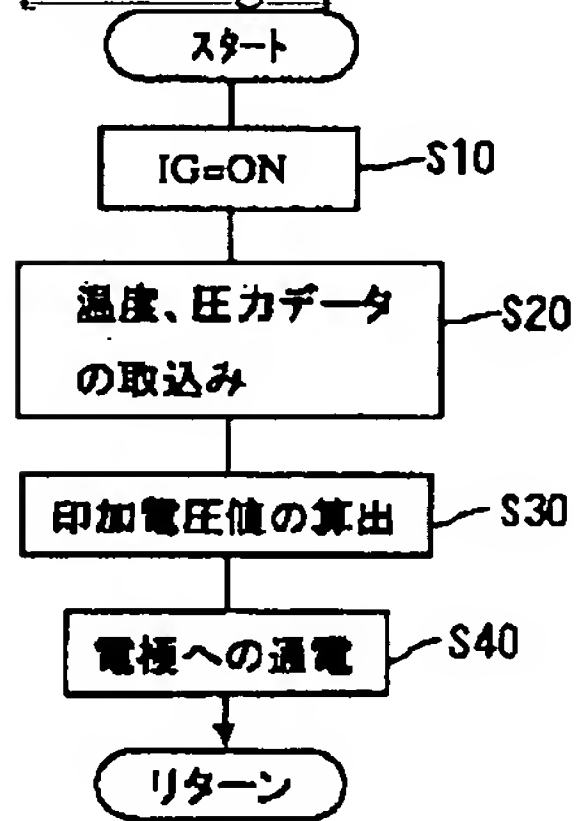
[Drawing 7]



[Drawing 8]



[Drawing 9]



[Translation done.]

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.